Chemistry **Name _____**

Intro to Stoichiometry: Mole ratios **Date _____**

Block _____

Write the balanced equation for the reaction between hydrochloric acid and sodium bicarbonate (baking soda). Use appropriate symbols to identify the physical state of each of the substances.

The coefficients in a balanced equation are the mole ratios for the substances in the reaction.

Purpose: To determine the mole ratio of sodium bicarbonate to sodium chloride based on the balanced equation.

Procedure:

1) Mass a clean, dry test tube
2) Add 1.0 g of sodium bicarbonate to the test tube and mass
3) Add 6M HCl drop-wise until all the sodium bicarbonate is reacted
4) Gently boil the water out of the test tube
5) Mass the test tube and sodium chloride (heat to constant mass).
6) Fill in the data table below and find the experimental mole ratio of sodium bicarbonate to sodium chloride.

Data Table

Mass of test tube	
Mass of test tube and $NaHCO_3$	
Mass of $NaHCO_3$	
Moles of $NaHCO_3$	
Mass of test tube and NaCl	
Mass of NaCl	
Moles of NaCl	
Moles $NaHCO_3$/Moles NaCl	

Mole conversion calculations:

Compare the actual mole ratio and the experimental mole ratio. What are possible sources of error?

Questions/Calculations: Show all calculations.

1. Write the balanced equation for this reaction.

2. There are actually two types of reactions occurring here – identify them.

3. Referring to the coefficients in this equation:
   - What is the ratio of moles of $NaHCO_3$ reacted to moles of NaCl produced?
   - What is the ratio of moles of $NaHCO_3$ reacted to moles of H_2O produced?
   - What is the ratio of moles of $NaHCO_3$ reacted to moles of CO_2 produced?

4. What mass of $NaHCO_3$ did you use in this reaction? Convert this mass to moles.

5. Based on the actual number of moles used and the coefficients in the balanced equation, how many moles of NaCl would you expect to produce? Convert this number of moles of NaCl to mass in grams. This predicted value is known as the theoretical yield.

6. Based on the expected ratio, how many moles of H_2O would you expect to produce? Convert this number of moles to number of molecules of H_2O.

7. How many moles of CO_2 gas would be expected? Convert this value to STP volume.

8. The hydrochloric acid you used was an aqueous solution of the compound hydrogen chloride. In its pure form, hydrogen chloride is a gas. Only the molecules of HCl participated in the reaction. The water provided the environment in which the HCl was able to react. How many moles of HCl were consumed by the $NaHCO_3$ as it reacted?

9. What procedural step was used to guarantee that enough moles of HCl were provided by the acid to react *all* of the $NaHCO_3$?

   What happened to the *excess* HCl?
   (Because there was more than enough HCl used in this reaction, it is called the "excess reagent".)

10. What mass of NaCl was actually produced? This value is known as the actual yield.

11. We often express yields (amounts of product formed) in terms of percentage. The *percent yield* is a calculation reflection how much of the theoretical amount was actually produced:

$$\frac{\text{Actual yield (g)}}{\text{Theoretical yield (g)}} \times 100\%$$

    (100% yield would be a perfect outcome)
    Calculate the percent yield of your NaCl.
    Compare/contrast this calculation to the *percent error* process.

12. If you had started with 7.5 grams of $NaHCO_3$ and sufficient HCl for a complete reaction, what mass of NaCl would you expect to produce?

13. If you wanted to produce exactly 1.75 grams of NaCl, what mass of $NaHCO_3$ would you start with (assuming a "perfect" procedure)?